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HARMFUL AQUATIC ORGANISMS IN BALLAST WATER

Comments on draft Regulation E-2
Concentrations of organisms delivered in ships' ballast water in the absence of any treatment: Establishing a baseline for consideration of treatment efficacy

Submitted by the International Council for the Exploration of the Sea (ICES)

SUMMARY

Executive summary: This document has been submitted by the Chairmen of the ICES/IOC/IMO Study Group on Ballast Water and other Ship Vectors (SGBOSV), Stephan Gollasch (Germany) and Steve Raaymakers (IMO GloBallast Programme Co-ordination Unit), on behalf of the International Council for the Exploration of the Sea (ICES). This submission is based on the meeting of SGBOSV, held in March 2003 in Vancouver, Canada. The Study Group discussed the basis of the bracketed numbers in the draft Regulation E-2 and developed a database of known organism concentrations in ballast tanks, so as to guide the scientific determination of ballast water management standards. These data establish a current baseline level or threshold of organism delivery, against which treatment and management efficacy should be measured. The proposed ballast water treatment/ management should result in a substantial reduction below the current baseline level of organism concentrations delivered in untreated ballast tanks.

The full meeting report of the 2003 meeting of SGBOSV will soon be available at www.ices.dk. The content of this submission does not necessarily represent the views of ICES.

Action to be taken: Paragraph 12

Related documents: MEPC 48/2; MEPC 48/2/1; MEPC 49/2/3

Introduction

1 Mr. Michael Hunter (United Kingdom), Chairman of the Ballast Water Working Group convened during MEPC 48, requested scientific input to provide a scientific reasoning for the individual numbers in draft Regulation E-2.

2 The second Intersessional Meeting of the Ballast Water Working Group (IBWWG) discussed Regulation E-2 and recommended a new format for consideration at MEPC 49:

> "Ships conducting Ballast Water Management in accordance with this Regulation shall discharge no more than [25] viable individuals per litre of zooplankton greater than [10]µm in size; and no more than [200] viable cells per ml of phytoplankton greater than [10]µm in size; and discharge of a specified set of indicator microbes shall not exceed specified concentrations".

3 The Ballast Water Working Group concluded that there was not sufficient time and scientific resources at the MEPC-IBWWG to determine the specific size and concentration in brackets. Some concern was expressed that the individual numbers in brackets for both, total phytoplankton and zooplankton abundance may not provide meaningful protection of species invasions (MEPC 49/2/3, paragraphs 2.63 to 2.65).

4 SGBOSV agreed that the finalisation of this standard is vital so as to provide the R&D community with a clear benchmark to aim for in developing alternative treatment technologies. It was also made clear that organism concentration values currently inserted in the draft standard are subject to negotiation. Expert scientific input is urgently required to inform this process and ensure that scientifically defensible and environmentally meaningful values are adopted in the Convention.

5 Identification of specific standards for ballast water treatment remains unresolved. It is certain that removing all organisms from ballast water would prevent associated invasions. It is also clear that reducing organism concentrations will reduce the likelihood of invasions. However, the specific level of reduced invasion risk achieved with each incremental reduction in organism concentration is presently not known.

6 As a minimum standard, to achieve any reduction in invasion risk, ballast water treatment must result in a substantial reduction in the concentrations of organisms compared to untreated ballast water. In particular, treatment should reduce the concentrations of coastal organisms, which can colonize and significantly impact coastal (including marine, brackish and freshwater) ecosystems.

7 This document summarizes data on the concentrations of viable organisms that arrive in ballast water that has not undergone any treatment or management. This is intended to characterize the current level of delivery against which treatment and management efficacy (standards) should be considered.

Executing Institutions

8 The Study Group on Ballast Water and Other Ship Vectors (SGBOSV) is a joint activity of ICES, IMO and IOC. The SGBOSV is composed of an international group of scientists, with extensive knowledge about the biology of ship-mediated transfers and invasions. The SGBOSV strives to advance scientific understanding of biological invasions associated with ships that is needed to guide management and policy decisions.

9 At the 2003 meeting of SGBOSV in total 41 participants from Australia, Belgium, Canada, France, Germany, Ireland, Italy, the Netherlands, New Zealand, Norway, Russia, Sweden, the United Kingdom, the United States of America and the GloBallast Programme (GloBallast), International Maritime Organization (IMO) attended (Annex 4). The Chairman of

the IMO Ballast Water Working Group, Mr. Michael Hunter, who also attended the 2003 meeting of SGBOSV, appealed to the Study Group to provide advice and input, in time for consideration by MEPC 49. Responding to the need for scientific input, and as requested by Mr. Hunter, SGBOSV discussed the bracketed individual numbers in draft Regulation E-2.

Methodology

10 Study Group member Dr. G. Ruiz of the Smithsonian Environmental Research Center, United States volunteered to take the lead in developing a global database on organism concentrations based upon data provided by Study Group members. A questionnaire addressing concentrations of organisms measured in the ballast water of commercial vessels was sent to the members of SGBOSV shortly after the meeting.

11 The information provided was summarized and is attached as annex 1 to this document. SGBOSV hopes that the datasets will support the development of ballast water standards of the Ballast Water Convention.

Action requested of the Committee

12 The Committee is requested to take the data provided in the annexes to this document into account and comment, as it deems appropriate.

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ANNEX 1

1 The ICES/IOC/IMO SGBOSV discussed the basis of the bracketed numbers in the draft Regulation E-2 and agreed that it is necessary to consider the concentrations of organisms in ballast tanks. This provides an important framework to understand the transfer of biota and to guide the development of ballast water treatment standards.

2 The SGBOSV has developed a database to characterize the concentrations of organisms measured in ballast tanks.

3 The information of this database is summarized here and intended to provide a baseline measure of what arrives in ballast water without any treatment, to better inform discussions at IMO.

Methodology

4 Data were included only for ballast water of coastal origin (< 100 km offshore) that was not exposed to ballast water exchange or an alternate treatment. These data included ballast water sampled from multiple vessel types (tankers, bulk carriers, container vessels, etc.) and with a broad range of ages.

5 The concentrations of organisms were summarized according to four general taxonomic groups: zooplankton, phytoplankton, bacteria, and virus-like-particles. These data derive from multiple studies, conducted at various ports, encompassing all seasons. The sources of data, and details of methods, are shown in annex 2.

6 These data are restricted to the ballast water only and do not include estimates for sediments or biofilms.

7 Summary statistics were calculated for each taxonomic group, to characterize the concentration of organisms present in untreated ballast water.

Results

8 For ***zooplankton***, summary statistics are based upon n=429 ballast tanks sampled (see Annex 3), mostly from individual vessels (i.e., a single tank at the end of independent vessel voyage), as follows:

(a) The median was 0.4 individuals per litre, indicating that half of the samples had concentrations above this value and the other half below this value.

(b) The mode was 0.1 individuals per litre. The mode is simply the individual value (concentration) most commonly observed among all samples, compared to any other single value.

(c) The mean number of zooplankton was 4.64 individuals per litre (standard error =0.708).

(d) The range of concentrations was 0 - 172 individuals per litre.

(e) These values are a conservative estimate of concentrations because samples were collected with nets with mesh openings that ranged from 55-80 μm and so only zooplankton larger than the mesh size were collected.

(f) The frequency distribution of zooplankton concentrations is shown in Figure 1 (annex 3).

9 For ***phytoplankton***, summary statistics are based upon n=273 ballast tanks sampled (see annex 3), mostly from individual vessels (i.e., a single tank sampled at the end of independent vessel voyages), as follows:

(a) The median was 13,300 phytoplankton cells per litre, indicating that half of the samples had concentrations above this value and the other half below this value.

(b) The mode was 1.0 phytoplankton cells per litre. The mode indicates the individual value most commonly observed among all samples, compared to any other single value.

(c) The mean number of phytoplankton was 299,202 phytoplankton cells per litre (standard error = 183,637).

(d) The range of concentrations was 1 - 49,716,400 phytoplankton cells per litre.

(e) These values are a conservative estimate of concentrations for phytoplankton above 10 μm, because samples were sieved with mesh sizes that ranged from 0-10 μm (0 means samples were not concentrated).

(f) The frequency distribution of phytoplankton concentrations is shown in Figure 2 (annex 3).

10 Fewer data were available for concentrations of ***bacteria*** and ***virus-like-particles*** in ballast water, limiting characterization in a similar fashion to zooplankton and phytoplankton. Instead, we simply report mean values and ranges.

(a) The mean number of bacteria from n=11 ballast tanks was 8.3×10^8 cells per litre (standard error = 1.7×10^8), ranging from 2.4×10^8 to 1.9×10^9 cells per litre.

(b) The mean number of virus-like particles (VLPs) from n=7 ballast tanks was 7.4×10^9 VLPs per litre (standard error = 2.3×10^9), ranging from 0.6×10^9 to 14.9×10^9 VLPs per litre.

Conclusions & Recommendations

11 Considerable variation exists in the concentrations of organisms arriving in unexchanged/untreated ballast water among vessels. Some of this variation is explained by (a) season and (b) voyage duration. Several studies also indicate that considerable variation exists among ballasting events, within the same port and season, which undoubtedly contribute to the observed variation.

12 The median concentrations of organisms estimated by this analysis for unmanaged ballast water provide a useful frame of reference in consideration of ballast water standards.

(a) The median is one approach to characterize the distribution of concentrations observed in unmanaged ballast water, as it presently arrives.

(b) By definition, 50% of all ballast tanks sampled in this analysis had concentrations below the median value and the other 50% had concentrations above the median.

(c) A significant risk of invasions still exists at the observed median concentrations.

13 To significantly reduce the risk of invasions associated with ballast water beyond the present situation, permissible discharge concentrations identified by any treatment/management standards should fall greatly below the median values observed presently in untreated / unmanaged ballast water.

14 Any standard should strive to reduce the transfer of organisms to the maximum extent possible, to minimize the likelihood of invasions, as it is clear that the risk of invasion (a) exists with any organism transfer and (b) increases with increasing concentrations of organisms.

15 Recognizing the inherent risk with any discharge, and the current concentrations delivered in untreated ballast water, SGBOSV recommends standards at least 3 orders of magnitude below the observed median concentrations for zooplankton and an equivalent or higher level of reduction for phytoplankton.

(a) **Zooplankton**

The median was 0.4 individuals per litre (see above) what is equivalent to 400 individuals per cubic meter. A three orders of magnitude reduction results in 0.4 individuals per cubic meter.

(b) **Phytoplankton**

The median was 13,300 phytoplankton cells per litre (see above). A three orders of magnitude reduction results in 13.3 individuals per litre.

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ANNEX 2

Source of data compiled in database and used in analyses. Sample size refers to number of ballast tanks sampled.

Organism Type	Source	Number of Samples	Sieve Size (μm)	Geographic Region	Ship Types
Zooplankton					
	S. Gollasch	101	55	Germany	Container, Ro-Ro, Tanker
	G. Ruiz et al.	205	80	Eastern U.S.	Bulker
	G. Ruiz et al.	123	80	Alaska	Tanker
Phytoplankton					
	S. Gollasch	61	10	Germany	Container, Ro-Ro, Bulker
	T. McCollin	105	0 (not sieved)	Scotland	Bulker, Cargo, Tanker
	T. McCollin & I. Lucas	107	0 (not sieved)	England & Wales	Bulker, Container, Ro-Ro, Tanker
Bacteria					
	G. Ruiz, F. Dobbs, & L. Drake	11	0 (not sieved)	Eastern U.S.	Bulker
Viruses					
	G. Ruiz, F. Dobbs, & L. Drake	7	0 (not sieved)	Eastern U.S.	Bulker

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ANNEX 3

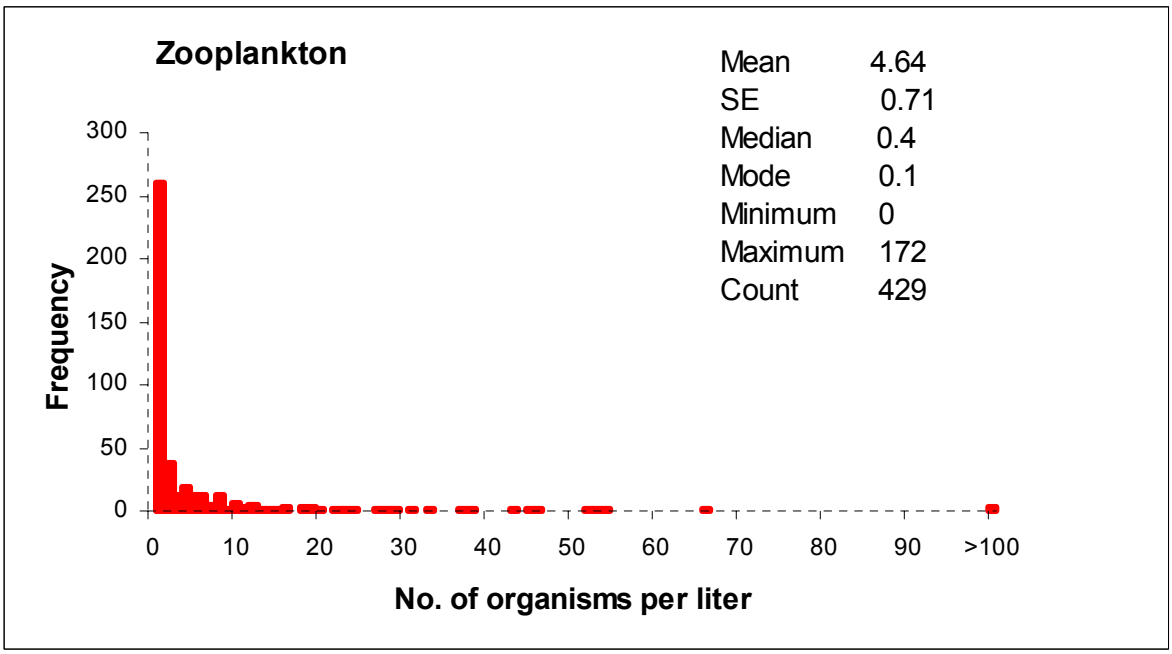

Figure 1. Frequency of zooplankton concentrations in ballast water. Shown is the frequency of zooplankton concentrations (no. per litre) measured in samples from ballast tanks (n=429).

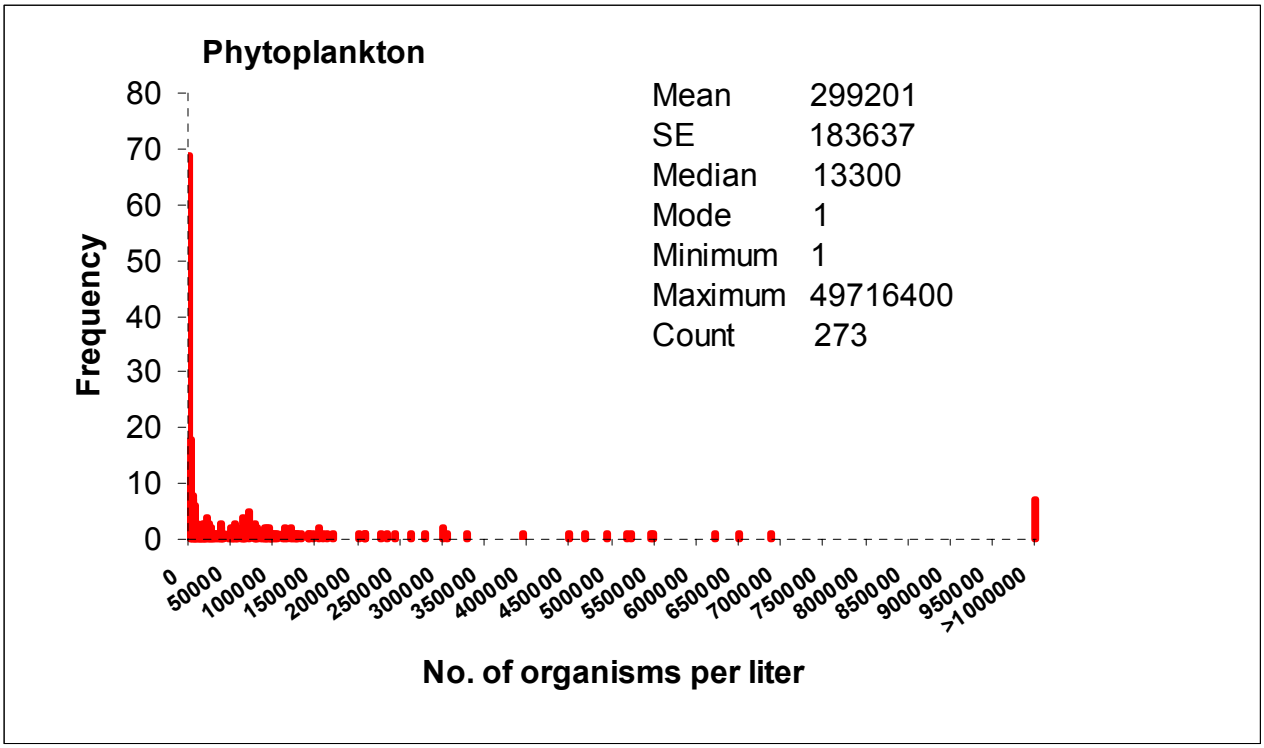

Figure 2. Frequency of phytoplankton concentrations in ballast water. Shown is the frequency of phytoplankton concentrations (no. per litre) measured in samples from ballast tanks (n=273).

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ANNEX 4

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